REMARKS

Claims 5 - 8 were rejected under 35 U.S.C. § 102(b) as being anticipated by Schwalm. The rejection of the claims 5 - 8 is traversed.

The Schwalm (U.S. 4,445,945) invention discloses an improved method of controlling the atmosphere of a furnace used in heat treating steel or iron. In accordance with the method and the furnace disclosed in the embodiment, it is apparent that the Schwalm invention is only applicable to the condition under atmospheric pressure. Namely, The Schwalm invention teaches nothing of carburization that is carried out under a pressure of 13 to 4,000 Pa at all.

On the other hand, in the present invention, a carburizing method and carburizing apparatus which is capable of performing a vacuum carburization under the reduced pressure of 13 to 4,000 Pa is provided. Accordingly, it is clear that even though the name of the analyzer which analyzes the gas in the state of atmospheric pressure and the reduced pressure is the same, they are completely different in view of constructions such as having an air-tight structure. The present invention has an airtight structure to maintain the reduced pressure.

Further, since it is very difficult to directly analyze the atmosphere gas under the reduced pressure of 13 to 4,000 Pa, in the present invention, analysis means such as oxygen sensor is developed to solve this problem, and from the sensor, a feedback control of the analyzed results realized by keeping a same level of gas carburizing. However, in the Schwalm invention does not show or disclose carburization under a reduced pressure of 13 - 4000 Pa.

Moreover, in the Schwalm invention, analyzer (6) or (8) used for conventional gas carburizing method is disclosed. Thus, since it does not have an air-tight structure and is greatly influenced by catalyst action of hydrocarbon, it is impossible to be used under the reduced pressure of 13 to 4,000 Pa.

In the Schwalm invention, although measurement of flame temperature is disclosed, measurement of thermal conductivity is not shown. Note that there is no direct relation between the flame temperature and the thermal conductivity. Namely,

the temperature of flame which has burned in the atmosphere is measured in the Schwalm invention, but the thermal conductivity is measured for the gas under the reduced pressure of 13 to 4,000 Pa in the present invention.

Finally, as amended, claim 5 claims in the present invention that the gas analysis means is an instrument for measuring a thermal conductivity and with said measurement, the atmosphere gas is analyzed while introducing and controlling an amount of hydrocarbon in the atmosphere gas. However, the Schwalm and Waka, (U.S. 6,187,111 B1) do not teach or suggest the unique construction requirements of the claim 5 of the present invention.

Claims 1 - 4 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Schwalm in view of Wake et al. The Examiner alleges that because reduction of sooting under carburization would also be recognized as desirable in the process described by Schwalm, motivation to maintain the heat tubing atmosphere at a level between 13 and 4,000 Pa, as taught by Wake to reduce sooting would have been a modification obvious to one of ordinary skill in the art at the time the invention was made. The rejection of claims 1, 2, and 4 is traversed. Claim 3 is now cancelled.

In the Schwalm invention, the atmosphere gas consisting of a mixture of methanol and nitrogen under the atmospheric pressure is formed and the CO content of 20% to 30% by volume is maintained. However, the method disclosed in the Schwalm invention is completely different from the vacuum carburizing method of the present invention.

In the present invention, since under the reduced pressure of 13 to 4,000 Pa, CO of 30% by volume or less is made, there is very little CO concentration compared with the method of the Schwalm invention by about 1/25. Accordingly, no inter-granular oxidation takes place in the surface of an object to be treated. But, inter-granular oxidation surely occurs in the Schwalm invention. Since in the Schwalm invention, the gas carburizing method is used, the carburization is mainly performed on the balanced reaction of CO gas. On the other hand, in the present

invention, an absolute quantity of CO is very small, the carburization is performed mainly by the decomposition reaction of hydrocarbon.

Further, in the Waka invention, a pressure of 1 to 10 kPa is used by a vacuum carburizing. The pressure range overlaps the reduced pressure of 13 to 4,000 Pa according to the present invention. However, even if the carburization is carried out only under the pressure range without controlling the composition of the atmosphere gas, reduction of sooting during carburization cannot be obtained. Namely, as amended claim 1 claimed in the present invention, the composition of the atmosphere gas during carburization is analyzed by measuring a thermal conductivity of said atmosphere gas. Accordingly, a proper carburization without unevenness can be realized under the reduced pressure of 13 to 4,000 Pa. Again, the Schwalm and Waka disclosures do not teach or suggest the distinguished feature of the claim 1 according to the present invention.

In summary, each of the Schwalm and Waka inventions does not disclose or suggest any of the above unique features and the equivalent remarkable effect cannot be obtained inevitably. Therefore, the present invention has novelty and inventiveness over the Schwalm, Waka and their combination.

This Amendment should place this case in condition for passing to issue. Such action is requested.

Respectfully submitted,

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